CASA IMMUNIZATION COVERAGE SURVEY

2001

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ACRONYMS

4-3-1-3-3	4 doses of DTP, 3 doses of Polio, 1 dose of MMR, 3 doses of Hib, and 3 doses of HepB vaccines
3-2-2-2	3 doses of DTP, 2 doses of Polio, 2 doses of Hib, and 2 doses of HepB vaccine
AAP	American Academy of Pediatrics
ACIP	Advisory Committee on Immunization Practices
CASA	Clinic Assessment Software Application
CDC	Centers for Disease Control and Prevention
CII	National Childhood Immunization Initiative
DTP3	3 doses of diphtheria, tetanus, and pertussis vaccine
DTP4	4 doses of diphtheria, tetanus, and pertussis vaccine
HepB2	2 doses of hepatitis B vaccine
HepB3	3 doses of hepatitis B vaccine
Hib2	2 doses of *Haemophilus influenza* type b vaccine
Hib3	3 doses of *Haemophilus influenza* type b vaccine
KDHE	Kansas Department of Health and Environment
MMR1	1 dose of measles, mumps, and rubella vaccine
MOGE	Moved out of the area or going elsewhere for health care
NIS	National Immunization Survey
Polio2	2 doses of polio vaccine
Polio3	3 doses of polio vaccine
PHS	Public Health Services
VAR1	1 dose of varicella vaccine

CASA 2001

Executive Summary

Coverage rates of children two years of age in 2001 were assessed at local health departments to see whether Kansas reached the 90% coverage goals set by the Centers for Disease Control and Prevention (CDC) and the National Childhood Immunization Initiative (CII). Immunization coverage rates in the two-year old cohort were measured for 4 doses of diphtheria, tetanus, and pertussis (DTP4), 3 doses of polio (Polio3), 1 dose of measles, mumps, and rubella (MMR1), 3 doses of *H. influenzae* (Hib3), 3 doses of hepatitis B (HepB3), and 1 dose of varicella (VAR1). The combination of DTP4, Polio3, MMR1, Hib3, and HepB3 (4-3-1-3-3) was analyzed as well. One-year old children were also included in this assessment in order to identify non-immunized and under immunized children sooner. Evaluation of coverage rates for the one-year old children in 2001 included the following: 3 doses of diphtheria, tetanus, and pertussis (DTP3), 2 doses of polio (Polio 2), 2 doses of *H. influenzae* (Hib2), 2 doses of hepatitis B (HepB2), and the combination of DTP3, Polio2, Hib2, and HepB2 (3-2-2-2).

For the children in the two-year old cohort, the number of local health departments achieving the 90% coverage goal has increased for MMR1 and the 4-3-1-3-3 combination compared to data from 2000, but only 38 counties achieved 90% coverage for the 4-3-1-3-3 combination. The statewide mean coverage rates for all single vaccines and the 4-3-1-3-3 combination remained the same compared to the mean coverage rates from the previous year. Mean coverage rates for individual vaccines for Polio3, MMR1, Hib3, and HepB3 exceeded the 90% coverage goal statewide. Also, counties with the lowest third of coverage rates for the 4-3-1-3-3 are geographically clustered in the southwest region and eastern third of Kansas. These counties represent 33% of the of all counties in Kansas but represent almost half of the population.

For the one-year old cohort, the statewide mean coverage rates decreased slightly compared to the statewide mean coverage rates from the previous year. For Polio2, Hib2, and HepB2 mean coverage rates bettered 90% and DTP2 and the 3-2-2-2 combination mean coverage rates were greater than 80%.

Coverage rates were also evaluated at the interim time points. In both age cohorts at age of 3 months, at least 80% of the children were up-to-date for their immunizations. However, coverage rates decreased by 30 percentage points by 7 months of age. Then at 12 months of age, the coverage rates increased to levels slightly higher than those at 3 months of age. However, in the two-year old cohort, coverage rates decreased again at 16 months of age by almost 20 percentage points and then began to rise again until 24 months of age where at least 83% of the children are fully immunized.

Children who start their immunization series on time by 3 months of age were compared to children who started the series late. In the two-year old cohort, children who started on time were 1.7 times more likely to complete the series by 24 months of age than those who started late. In the one-year old cohort, children who started the immunization series on time were 1.8 times more likely to be up-to-date at 12 months of age than those who started late.

BACKGROUND

Immunization of children against nine diseases has proven effective in reducing the morbidity and mortality of those diseases. For this reason, the Centers for Disease Control and Prevention (CDC) and the National Childhood Immunization Initiative (CII) have set goals of 90% immunization coverage for all children by their second birthday of the following single antigens and a combination of all vaccines: 4 doses of diphtheria, pertussis, and tetanus vaccine (DTP4); three doses of polio vaccine (Polio3); one dose of measles, mumps, and rubella vaccine (MMR1); three doses of *Haemophilus influenzae* type b vaccine (Hib3); three doses of hepatitis B vaccine (HepB3); and 1 dose of varicella (VAR1). The combination of DTP4, Polio3, MMR1, Hib3, and HepB3 is referred to as the 4-3-1-3-3 combination.

Even though no immunization coverage goals for one-year old children have been established, children are expected to have received the following immunizations by their first birthday: 3 doses of diphtheria, pertussis, and tetanus vaccine (DTP3); two doses of polio vaccine (Polio2); two doses of *Haemophilus influenzae* type b vaccine (Hib2); and two doses of hepatitis B vaccine (HepB2). The complete set is referred to as the 3-2-2-2 combination vaccine. One-year old children were included in this assessment in order to identify non-immunized and under immunized children sooner and increase the possibility of these children receiving all immunizations by their second birthday.

The field staff at the Immunization Program from Kansas Department of Health and Environment assessed immunization levels of both two-year old, and one-year old children at all local health departments. The assessments included in this study were conducted between January 1, and December 31, 2001.

METHODS

Using the Clinic Assessment Software Application (CASA) designed by the CDC, immunization coverage rates were evaluated at all local health departments for children either one-year old or two-years old. The one-year old cohort included all children between the ages of 12 and 23 months and the two-year old cohort included all children between the ages of 24 and 35 months based on the date of assessment. Children were excluded if they were documented as having moved out of the area or gone elsewhere for health care (MOGE). For local health departments with 100 or fewer eligible records all records were examined. For local health departments with a larger number of records, either a listing of eligible children was generated and then a random sample of at least 100 records was chosen and examined or all records were examined if the local health department had the capabilities.

At the local health departments, coverage rates for DTP4, Polio3, MMR1, Hib3, HepB3, VAR1 and the 4-3-1-3-3 combination were examined for the two-year old cohort. For the the one-year-old cohort, coverage rates for DTP3, Polio2, Hib2, HepB2, and the 3-2-2-2 combination were evaluated at each local health department. Results and explanations of the immunization assessment were given to each local health department. The local health departments were also provided with a list of all children from the sample that were not up-to-date for immunizations or were considered as a missed opportunity in order to help the health

departments identify the children who still needed at least one vaccine. A child is considered a miss opportunity if he/she visits the health department for any reason and does not receive all of the eligible immunizations.

Following an assessment at the local health department, immunization field staff discussed potential areas for improvement in management of the immunization clinic. Procedural changes such as changes in personnel, record keeping, tracking patients, and reminder/recall system were evaluated in order to better assess the changes on coverage rates. Factors that affect changes on coverage rates include implementation of computerized tracking system, new recall/reminder system, method of classifying children who had moved or gone elsewhere (MOGE), and change of immunization personnel. Each health department received an overall review of their immunization coverage rates with suggestions for increasing coverage rates.

Additional analysis using SAS 8.2 was performed on the aggregate data from all health departments. The percentage of local health departments achieving the 90% immunization coverage goal was examined for the two-year-old cohort. These results were compared to immunization rates for 2000 in order to determine increases or decreases in coverage rates over time.

Data from all health departments were combined and analyzed for mean, median, and range for single vaccines and combinations. Also the percent of children up-to-date for immunization at interim months of age were computed for each cohort.[1] For both cohorts, the interim months of age used were 3, 5, 7, 9 and 12 and the additional months of 16, 19, 21 and 24 were examined for the two-year old cohort.[2] The interim points of 3 and 24 months of age were used to assess the number of children that started their immunization series either on time or late and the number that finished on time or late for the two-year old cohort. Children who had received all necessary immunizations by the appropriate age were defined as on time and those who were missing at least one immunization recommended for that age were defined as late. The children late at 24 months were further examined to determine how many more immunizations they needed in order to be up-to-date. For the one-year old cohort, the interim points 3 and 12 months were used instead.

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[1]Statewide rates of immunization coverage were calculated by combining all children in the samples obtained from all counties. Each county's sample is obtained independently from all other counties' samples, and each sample represents a proportion of children which is different from county to county. Statewide rates calculated in this way may be inaccurate, and may not represent the rate that would be found if one probability sample was selected for the whole state, or if each county sample received an appropriate weight during the analysis. The only purpose of the calculation presented in this document is to allow comparisons at different ages, not to make inference on the true statewide rate for any age groups.

[2]Appropriate immunizations were based on the 2001 ACIP recommendations. MMWR 2001;50:7-10,19.

RESULTS

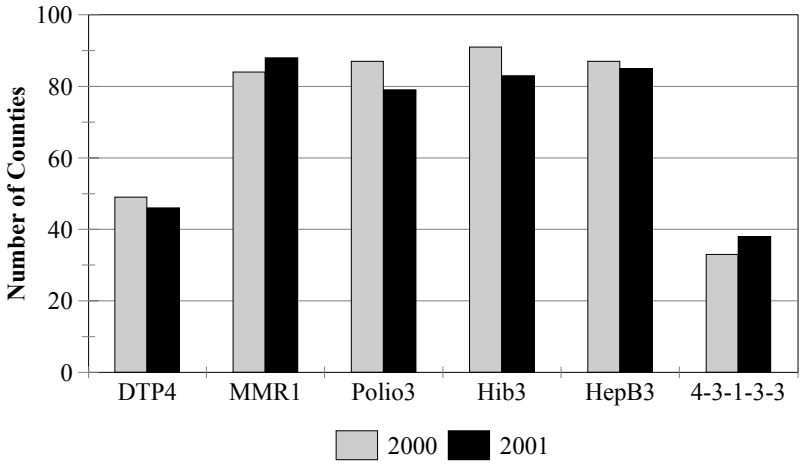
For the two-year cohort, 9871 records were reviewed with a range of 4 to 1491 records from 104 individual counties. The mean number of records examined for the two-year old cohort was 95 with a median of 57 records. For the one-year old cohort, 9666 records were reviewed with a range of 6 to 1874 records from 98 counties. In the one-year old cohort, a mean of 99 records and median of 53 records were examined.

TWO-YEAR OLD COHORT

Counties Achieving the 90% Goal

The immunization coverage rate goal is 90% or better for single vaccines and for the combination of vaccines. The number of local health departments achieving 90% or better coverage increased for MMR1 and the 4-3-1-3-3 combination compared to the 2000 CASA report (Figure 1). Despite an increase for the 4-3-1-3-3 combination, only 38 counties have immunization coverage rates better than 90% for the full recommended series of 4-3-1-3-3. The greatest decrease in the number of counties achieving 90% of better was for Polio3 and Hib3 which had a decrease of 8 counties each.

FIGURE 1: Number of County Health Departments in Kansas Achieving 90% Immunization Coverage for Single Vaccines in the Two-Year Old Cohort for 2000 CASA and CASA 2001.



Statewide Mean, Median, and Range of Immunization Rates for Single and Combination of Vaccines

In the two-year old cohort, the statewide mean coverage rates for all single vaccines and 4-3-1-3-3 combination have remained the same compared the 2000 CASA report. The mean coverage rates exceed the coverage goal of 90% for Polio3, MMR1, Hib3, and HepB3 (Table 1). Coverage rates for VAR1 were examined for the first time in 2001 and the mean coverage rate was 60%. The median, or value that half of the counties meet or exceed, was also similar to the median values of the CASA 2000. An increase of variability among local health departments was seen in the widening of the range of immunization coverage rates. The variability of coverage rates among local heath departments increased for DTP4, Polio3, MMR1, and Hib3.

TABLE 1: Immunization Coverage Rate Mean, Median, and Range for Two-Year Old Cohort at County Health Departments in Kansas for the 2000 and 2001 CASA.

	2001			2000		
Vaccine	**Mean**	**Median**	**Range**	**Mean**	**Median**	**Range**
DTP4	86.2%	88.9%	47.2-100%	87.6%	89.2%	49.0-100%
Polio3	93.0%	95.3%	54.7-100%	93.2%	95.1%	68.0-100%
MMR1	94.2%	96.0%	58.5-100%	94.3%	96.3%	62.1-100%
Hib3	94.2%	95.4%	72.5-100%	95.0%	96.0%	76.8-100%
HepB3	94.1%	95.3%	71.3-100%	94.6%	96.3%	62.7-100%
4-3-1-3-3	83.9%	86.8%	45.3-100%	84.4%	86.2%	42.0-100%
VAR1	60.0%	64.0%	10-93.7%	n/a	n/a	n/a

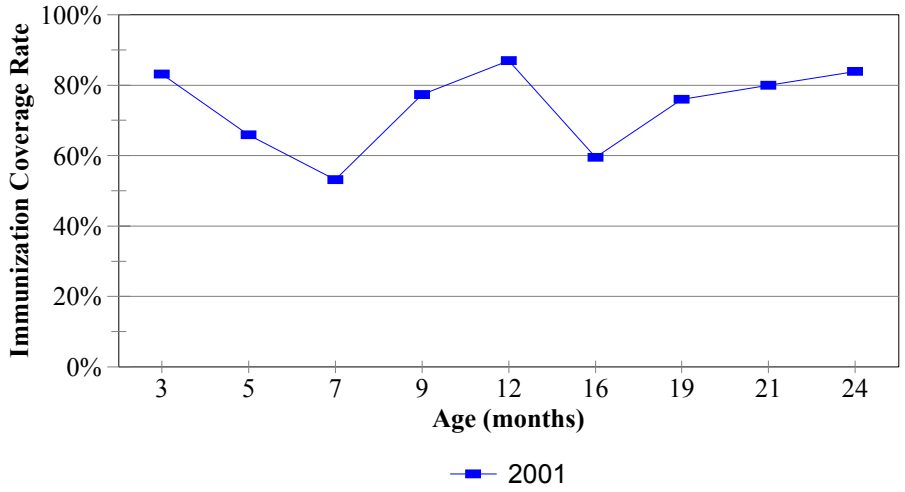
Mean Immunization Rates at Interim Time Points

Mean immunization coverage rates were examined at interim month time points. The immunizations needed at each time interval are listed in Table 2. At 3 months of age, the mean coverage rate was 83.1% (Figure 2). Immunization coverage rates decrease at 5 months of age and then again at 7 months of age. At 12 months of age, immunization coverage rates recover to 87%. The same pattern is repeated again with a large decrease of almost 30 percentage points at 16 months. By 24 months of age, mean immunization coverage rates recover again and finally reached the same coverage rate as at 3 months of age.

TABLE 2: Recommended Vaccines at Selected Time Points and Combined Immunization Coverage Rates for Two Year Old Cohort in Kansas for 2000 and 20001.

AGE	ANTIGEN	2001	2000
3 months	**DTP1, Polio1, Hib1, HepB1**	83.1%	84.1%
5 months	**DTP2, Polio2, Hib2, HepB2**	65.9%	67.1%
7 months	**DTP3**, Polio2, Hib2, HepB2	53.2%	53.4%
9 months	DTP3, Polio2, Hib2, HepB2	77.3%	77.3%
12 months	DTP3, Polio2, Hib2, HepB2	87.0%	86.9%
16 months	**DTP4, Polio3, Hib3, HepB3, MMR1**	59.5%	59.6%
19 months	DTP4, Polio3, Hib3, HepB3, MMR1	76.0%	76.0%
21 months	DTP4, Polio3, Hib3, HepB3, MMR1	80.0%	80.8%
24 months	DTP4, Polio3, Hib3, HepB3, MMR1	83.9%	84.4%

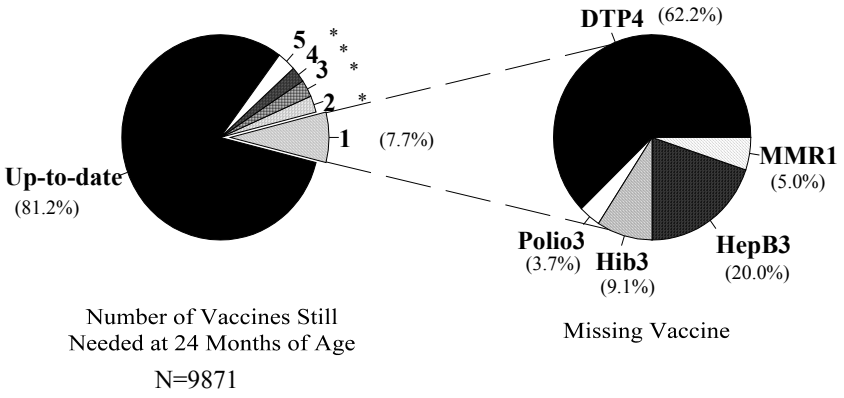
FIGURE 2: 2001 Mean Immunization Coverage Rates for Two-Year Old Cohort in Kansas at Selected Time Intervals.



The likelihood of being up-to-date for all immunization by 24 months of age depending on the up-to-date status at 3 months of age was also examined. At three months of age, 8196 children were up-to-date for DTP1, Polio1, Hib1, and HepB1. Of those children who started on time at 3 months, 87% (7164 children) had completed all necessary immunizations (DTP4, Polio3, HIb3, HepB3, and MMR1) on time by 24 months of age. However, only 51% (859) of the children who were late at 3 months of age were able to complete all immunizations by 24 months of age. **This means that children who start on time are 1.7 times more likely to complete the series on time by 24 months of age compared to those children who do not begin the series on time.** ($p < 0.001$)

At 24 months of age, 1848 (19%) of all two-year olds were behind schedule. Of those children, 760 only needed one more immunization in order to be up-to-date. If those children had received the missing immunization at 24 months of age, the statewide estimated immunization coverage rate for the 4-3-1-3-3 combination would have increased from 84% to 89%. Of those children needing just one immunization, almost two-thirds needed DTP4 in order to be up-to-date (Figure 3).

FIGURE 3: Number and type of immunization needed in order to be up-to-date at 24 months of age.



* Represents 3% or less of the records..

One-Year Old Cohort

Mean, Median, and Range of Statewide Immunization Rates for Single Vaccines and Combination of Vaccines

Mean coverage rates for Polio2, Hib2, and HepB2 exceeded 90% coverage. Compared to the one-year old cohort in 2000, the mean immunization coverage rates decreased slightly for all vaccines and the 3-2-2-2 combination of vaccines. Along with the slight decrease in mean coverage rates, the variability of the coverage rates among the counties widened. The greatest variability was found among the DTP3 and 3-2-2-2 combination, both which had a range greater than 46 percentage points.

TABLE 3: Immunization Coverage Mean, Median, and Range for One-Year Old Cohort at County Health Departments in Kansas for the 2000 and 2001 CASA.

	2001			2000		
ANTIGEN	**Mean**	**Median**	**Range**	**Mean**	**Median**	**Range**
DTP3	85.2%	88.1%	53.6-100%	86.6%	88.9%	56.4-100%
Polio2	93.1%	95.9%	62.2-100%	94.7%	96.0%	74.5-100%
Hib2	93.2%	96.1%	65.2-100%	94.1%	96.0%	76.4-100%
HepB2	93.3%	95.6%	63.7-100%	95.6%	97.0%	75.4-100%
3-2-2-2	83.7%	86.3%	53.6-100%	85.2%	87.5%	56.4-100%

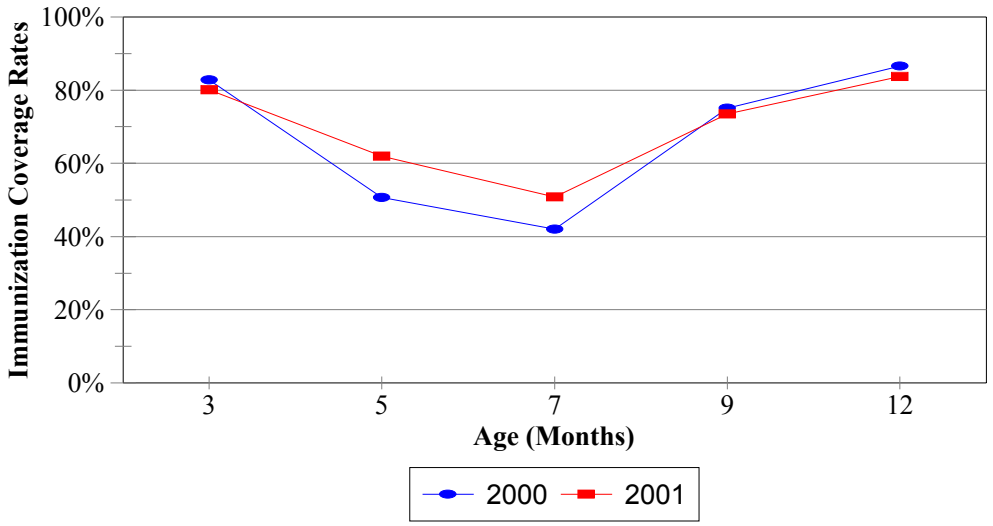
Mean Immunization Rates at Interim Time Points

Like the two-year old cohort, the one-year old cohort immunization coverage levels were assessed at interim months. At 3 months of age, 80% of the children were fully immunized for DTP1, Polio1, Hib1, and HepB1 (Table 4, Figure 4). However, the mean immunization coverage rates decreased by 30 percentage points by 7 months of age where only half of the children were fully immunized for DTP3, Polio2, Hib2, and HepB2. Even though immunization coverage rates did not decrease as much at the 5 and 7 month time periods compared to the decrease in coverage rates for the one year old cohort in 2000, coverage rates at 12 months of age for the 2001 cohort were slightly lower. Finally by 12 months of age, immunization coverage rates returned to levels similar to those at 3 months of age.

TABLE 4: Recommended Vaccines at Each Time Point and Combined Immunization Coverage Rates for One Year Old Cohort in Kansas for 2000 and 2001.

AGE	ANTIGEN	2001	2000
3 months	**DTP1, Polio1, Hib1, HepB1**	80.1%	82.8%
5 months	**DTP2, Polio2, Hib2, HepB2**	62.0%	50.7%
7 months	**DTP3**, Polio2, Hib2, HepB2	50.8%	42.0%
9 months	DTP3, Polio2, Hib2, HepB2	73.5%	75.1%
12 months	DTP3, Polio2, Hib2, HepB2	83.7%	86.6%

FIGURE 4: Mean Immunization Coverage Rates for One-Year Old Cohort in Kansas at Selected Time Intervals for 2000 and 2001.



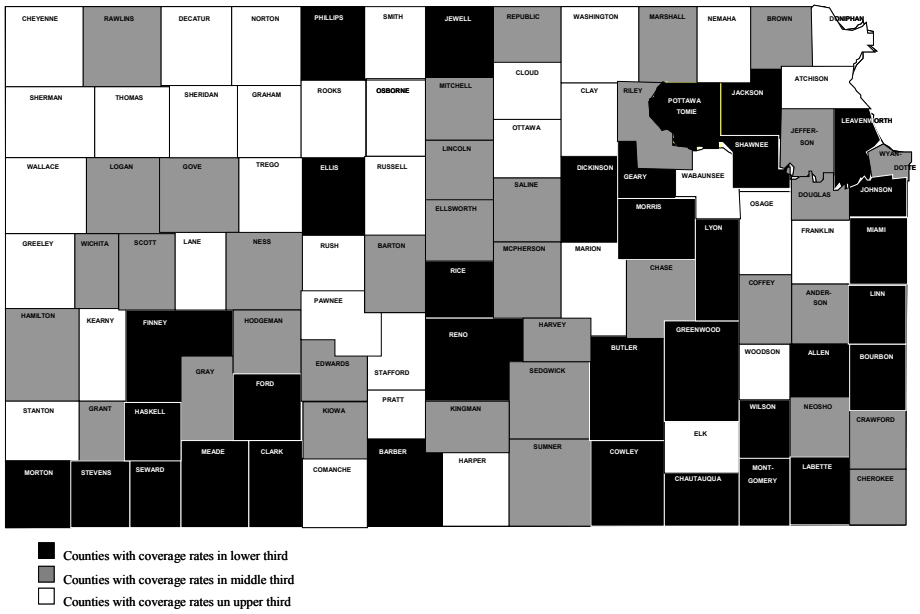
The likelihood of being up-to-date for the 3-2-2-2 combination by 12 months of age depending on the up-to-date status at 3 months of age, was also examined. At 3 months of age, 8196 children were up-to-date for DTP1, Polio1, Hib1, and HepB1. Of those children who were up-to-date at 3 months, 89% (6884 children) were up-to-date at 12 months of age for DTP3, Polio2, Hib2, HepB2. However, only 47% (922) of those children behind schedule were up-to-date at 12 months of age. **This means that children who are on time at 3 months of age are 1.8 times more likely to be up-to-date at 12 months age compared to those children who do not begin the series on time.** ($p < 0.001$)

DISCUSSION

Overall, the number of counties that achieved 90% coverage for MMR1 and 4-3-1-3-3 combination of vaccines increased compared to the number of counties that reached the same goal in the previous year; 38 counties had 90% or greater coverage for the 4-3-1-3-3 combination. At the same time, 8 fewer counties had 90% coverage for Polio3 and Hib3 compared to 2000.

Counties with the lowest third of coverage rates for 4-3-1-3-3 are geographically clustered in the southwest region and eastern third of Kansas (Figure 5). These counties while representing only about 33% of all counties include almost half (48.4%) of the population while counties in the upper third represent just 8.6% of the population. This is a clear representation of the challenge that local health departments in higher population settings have to face to reach their children with appropriate immunization.

FIGURE 5: Geographical Comparison of 4-3-1-3-3 Immunization Coverage Rates for the Kansas 2001 CASA.



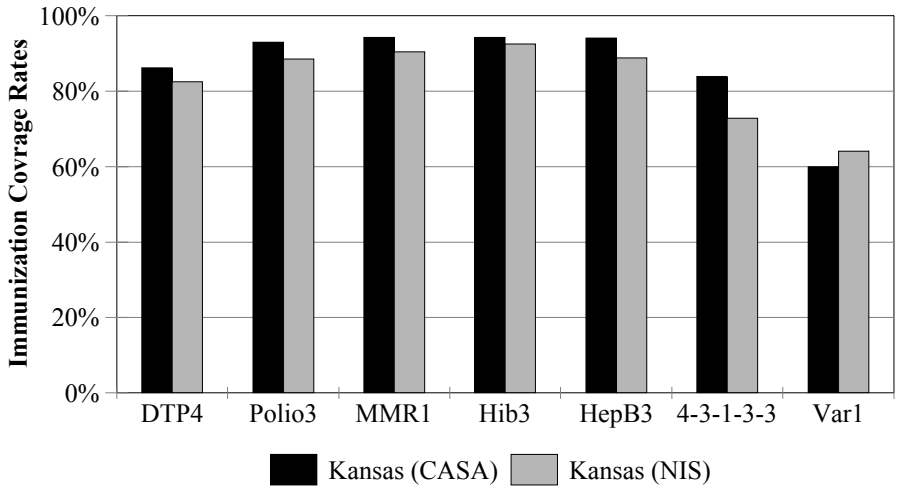
In March 2001, CDC recommended vaccine providers to defer the fourth dose of DTP if they had an insufficient supply to vaccinate infants with the first three doses.[3] Despite the deferral of DTP4, the children in the two-year old cohort appear to not have been affected by this

[3]Update on the Supply of Tetanus and Diphtheria Toxoids and of Diphtheria and Tetanus Toxoids and Acellular Pertussis Vaccine. MMWR 2001: 50:189-190.

recommendation. This is reflected in the statewide immunization coverage means which were the same in the 2001 CASA as the 2000 CASA for all DTP4 and the 4-3-1-3-3. Coverage rates for 1 dose of varicella were calculated for the first time this year and the statewide coverage mean for VAR1 was 60% with a range of 10% to 94%. However, children who were previously infected with disease were not recorded, therefore the total number of children protected against varicella is higher than those who are vaccinated.

The two-year old cohort results for 2001 CASA were compared to the 2001 National Immunization Survey (NIS) results for Kansas which refers to a similar time period as in this survey.[4] Immunization coverage rates for the 2001 CASA are greater than the 2001 NIS for the combination of vaccines and all single vaccines except for VAR1 (Figure 6). None of these differences in coverage rates is statistically significant except for the 4-3-1-3-3 combination. Despite the 2001 CASA not being a population based survey, coverage rate results are similar to the 2001 NIS data for Kansas which is based on a smaller sample size representing a larger population of children.

FIGURE 6: Comparison of Immunization Coverage Rates in Two-Year Old Between 2001 CASA and 2001 NIS for Kansas.



When immunization coverage rates at interim time points were examined, rates dropped from 66% at 5 months of age to 53% at 7 months of age (Table 2, Figure 2). The only added immunization required at that age was **DTP3**. One possible explanation for this drop is that

[4]Data for NIS was collected by the Centers for Disease Control and Prevention (CDC) through a telephone survey of randomly selected households. For accuracy, the healthcare providers (family physicians, pediatricians, etc.) of the children included in the survey were contacted by mail. NIS estimates were calculated using both household and provider data.

since only one immunization was needed parents postponed a visit until later when the child was eligible for more immunizations. Children who receive **DTP3** late then may not be able to receive **DTP4** on subsequent visits since the minimum interval between the two doses is 6 months.

At two years of age, 1848 (19%) of the children were behind schedule. Of those children not up-to-date, 41% were needing just one immunization. If a child had been eligible for an immunization at any visit at the health department and was not given the appropriate immunization, then this represented a missed opportunity. Adequately identifying missing immunizations on subsequent visits and then administering the vaccine will increase immunization coverage rates. DTP4 was the vaccine most often missing from the 4-3-1-3-3 series.

In the one-year old cohort, the statewide mean immunization coverage rates decreased slightly. The increase in the variability of coverage rates among the counties reflects this decrease in mean coverage rates. The range of coverage rates for Polio2, Hib2 and HepB2, each widened by 11 percentage points.

Despite slight decreases in immunization coverage rates at 12 months of age, children in the one-year old cohort had increased coverage rates at 5 and 7 months when compared to the 2000 CASA results. At 7 months of age there was an eight percentage point increase in coverage rates. At this time interim, DTP3 is the only immunization recommended.
This study had several limitations. The first was that this was not a population based study. This study only included children who attended a local health department for at least one of their immunizations and did not include children who attended for any reason, which might have resulted in an overestimation of coverage rates. On the other hand, an underestimation of coverage rates was also possible if immunizations records fail to identify children who have moved or gone elsewhere (MOGE) for immunizations. Immunization records may have been inaccurate as a result of the county health departments using different forms of record keeping.

Despite the limitations, this survey served as an effective tool for assessing immunization coverage rates both at the state level and at the county level. When assessing coverage rates at the county level, the CASA was a useful tool in swiftly identifying problem areas and under immunized children. For these reasons, this assessment will continue to be used to track the increasing immunization coverage rates in Kansas.